

Rotational Damping In Ytterbium (Yb) Nuclei

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When as little as one MeV of thermal energy is added to rotational nuclei, the level density become high and the levels mix. This process is the damping of the nucleonic motion from ordered to chaotic. However, this same high level density causes the emitted γ -ray spectra to consist of very many lines, currently unresolvable, making studies difficult. The unmixed bands have different rotational properties so that levels of the same spin emit rotational γ rays of different energies. The mixed levels can then emit γ rays having any of these energies. This "rotational damping" is an important change because a level of spin I no longer decays to a single level of spin $I - 2$ but to any of a number of levels. The resulting distribution of γ -ray energies emitted by a single level has a FWHM that is called the "rotational damping width" (Γ_{rot}).

To study rotational damping we can look at correlations in the spectrum in coincidence with a given γ -ray energy (the gate). A γ ray in the gate will be in coincidence with all the others in the rotational cascade, but not with itself. This generates a strong negative correlation at the gate energy, called the "rotational" correlation. We have found that the rotational correlation from damped bands is masked by a positive "feeding" correlation, which we can remove.

The results of this study are shown in Fig. 1. The overall agreement between the simulations and the data is good. The feeding correlations in Fig. 1 are subtracted from the other correlation spectra to isolate the rotational correlations, which are shown in Fig. 1 (right side) for both the data and the simulations. The best values for Γ_{rot} are the simulation inputs, which are 300 keV for these gates. Simulations with varying inputs and Γ_{rot} values show that the uncertainty limits on Γ_{rot} are about $\pm 20\%$. [F.S. Stephens et al., Phys. Rev. Lett. accepted 2002]

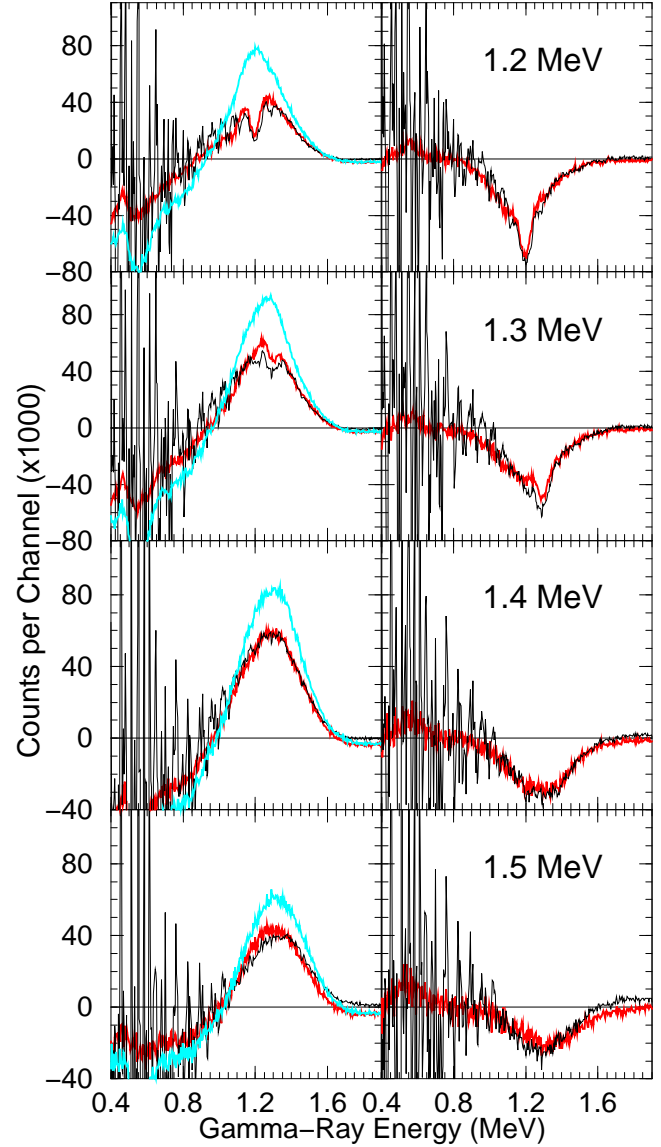


Figure 1: The black, red, and blue lines are correlation spectra (left) and differences (right) for the data, simulations, and feeding simulations, respectively, at four gate energies.